

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

875
U. S. DEPARTMENT OF
AGRICULTURE

FARMERS' BULLETIN No. 1026

STRAWBERRY
CULTURE
SOUTH ATLANTIC AND
GULF COAST REGIONS



LIBRARY
COASTAL PLAIN EXPERIMENT STATION
TIFTON, GEORGIA

STRAWBERRY growing is an important industry in certain districts of the South Atlantic and Gulf States.

Because of the mild climate, especially in the warmer parts, the plants grow during nearly the entire year.

Methods of culture and handling are quite different in many respects from those in other parts of the country; those which have proved successful are described and their significance indicated in this bulletin.

The commercial importance of one strawberry-growing district, compared with other districts, is determined largely by the ripening period of the crop. Fruit from the South Atlantic and Gulf coast regions is usually marketed when there is little or no competition.

Important strawberry-growing districts in the territory covered by this bulletin do not, as a rule, compete seriously with one another in the marketing of the crop.

Shipments of strawberries begin from central Florida early in the winter and continue in succession from the various districts northward until the fruit ripens in the northern districts.

With the help of the everbearing varieties of strawberries, it is possible for the consumer to whom price is no object to obtain fresh strawberries ripened in the open air almost any time in the year.

STRAWBERRY CULTURE: SOUTH ATLANTIC AND GULF COAST REGIONS

By GEORGE M. DARROW, *Senior Pomologist, Division of Horticultural Crops and Diseases, Bureau of Plant Industry*

CONTENTS

	Page		Page
Area to which this bulletin applies.....	1	Care of the plants after setting—Continued.	
Locating the plantation.....	2	Thinning the plants.....	19
Soil.....	3	Spacing the plants.....	19
Drainage.....	3	Tillage.....	19
Preparation.....	3	Companion cropping.....	20
Injury by nemas.....	4	Strawberries as an intercrop.....	21
Rotations.....	6	Mulching.....	22
Final preparation for planting.....	7	Use of green-manure crops.....	23
Establishing the plantation.....	8	Use of fertilizers and lime.....	23
Obtaining parent plants from the North.....	8	Irrigating.....	25
Raising fruiting plants.....	9	Renewing the plantation.....	27
Time of planting.....	10	Harvesting and shipping.....	28
Planting and training systems.....	11	Pickers and picking.....	29
Number of plants required to set an acre.....	13	Carriers and crates.....	31
Care of plants before setting.....	13	Suitable strawberry varieties.....	32
Setting the plants.....	14	Strawberry diseases and insect pests.....	33
Care of the plants after setting.....	18	Uses of the strawberry.....	33
Removing flower stems.....	18	Cold storage.....	34
Width of rows.....	18		

AREA TO WHICH THIS BULLETIN APPLIES

THE area to which this bulletin applies is shown in Figure 1. It includes in general the coastal plain region in Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia, and also a part of Arkansas.

Strawberries are shipped to northern markets from different districts in this region throughout the winter and early spring. The shipments totaled 6,965 carloads in 1930 and 10,465 carloads in 1931, or about two-thirds of the total shipments of the country.¹

The accompanying map (fig. 2) shows the large centers of strawberry production in the South, as well as in other regions of the country, and the approximate season of ripening in each.

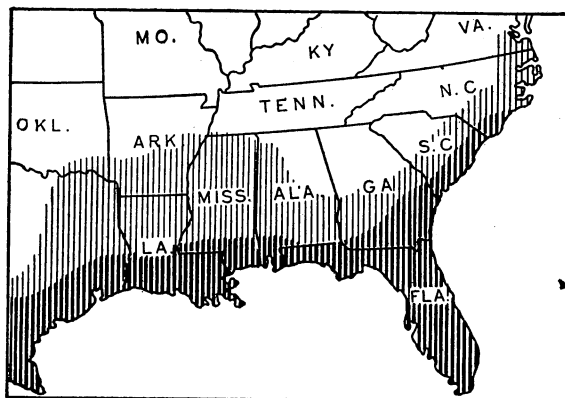


FIGURE 1.—The area to which this bulletin applies in the South Atlantic and Gulf Coast States is indicated by the shaded portions. The heavily shaded portion shows the regions where the hill system of strawberry culture is commonly practiced, and the light shading indicates sections where the matted row is used

¹ Figures subject to revision.

Strawberry-growing practices in the South are very different from those used in the Northern States, and for that reason directions applicable to strawberry growing in other parts of the country are of small value there.²

LOCATING THE PLANTATION

Factors that determine a favorable location for strawberry raising include: Facilities for shipping the fruit; convenience in obtaining pickers and crates, boxes, and other supplies; and the ripening time of the fruit in relation to its ripening time in other strawberry-growing districts. A location in which the berries ripen at a period when markets are not well supplied with them is better, other things being equal, than one in which the fruit ripens when it must meet

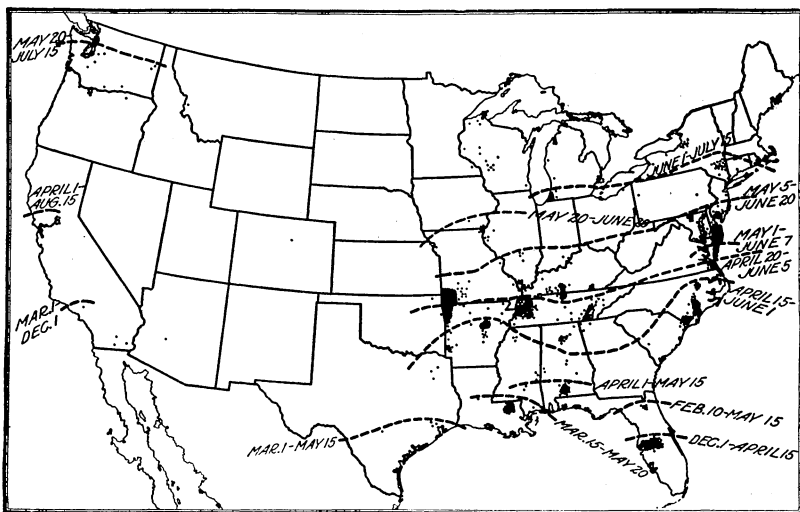


FIGURE 2.—Outline map of the United States, showing the approximate shipping season for each section. Dots show specific locations of the more important shipping areas

competition from the berries of other districts. It is usually easier to obtain transportation, supplies, and experienced help where strawberries are already being grown and shipped in quantities than in localities where strawberry growing is not a community interest.

The map in Figure 2 shows that the strawberry-ripening season moves northward during the winter and spring, and shipping from each district ends when berries in the district next north are ripe, unless a poor crop in some district provides growers south of that district with a profitable shipping season longer than usual. By noting the districts in which berries ripen at the same time and the railroad lines or highways over which they are shipped the logical market for berries from any given district can readily be determined.

Shipping seasons along the Atlantic coast succeed each other about as follows: The Plant City district in Florida is normally the only

² See Farmers' Bulletins 1027, Strawberry Culture: Western United States; 1028, Strawberry Culture: Eastern United States; and 1043, Strawberry Varieties in the United States.

source of strawberries for northern markets in December and January, and shipments from that district usually are at their height in February, when the Starke-Lawtey district in northern Florida begins to ship small quantities. In March shipments from the latter district become heavy and those from the Plant City district stop, unless late frosts or other weather conditions retard ripening in northern localities.

In the latter part of April shipments from North Carolina become heavy and those from northern Florida are discontinued. Then berries from the Norfolk district replace those from North Carolina, and are later superseded by shipments from districts still farther north. Similar crop successions occur in Alabama, Louisiana, Mississippi, Texas, and Arkansas.

SOIL

No particular type of soil is best adapted to the varieties of strawberries grown in a given area. In Texas, coarse sandy, fine sandy, and heavy gumbo soils are used extensively; in Louisiana, a heavy silt loam and sandy loam; in Florida, both heavy silt and coarse sandy loams and muck soils; and elsewhere still other soil types. In each section the soil type most easily managed and having the greatest content of humus (decaying vegetable matter) is generally preferred. In the vicinity of Houston, Tex., a gumbo soil mixed with a large quantity of sand is favored; in the section about Hammond, La., a silt loam mixed with sand; and in the Plant City district in Florida, a black sandy soil.

DRAINAGE

The strawberry is easily injured by poor soil drainage and requires soils on which water never stands. In the area to which this bulletin applies, this is especially important, for the land is usually low and often poorly drained. In winter the evaporation is less than at other seasons, and when heavy rains occur, the plants may be drowned out entirely or so weakened that their growth is stunted. Leaf, root, and fruit diseases will also be more abundant on such sites than where the drainage is good. Nemas (nematodes), very minute, wormlike organisms that cause the dwarf disease, may be washed from plants on high lands to those in low areas where the water stands.

PREPARATION

Land should be thoroughly prepared for growing strawberries. It should contain abundant supplies of humus when the plants are set. The humus may be supplied either by applying adequate quantities of manure, or by growing and turning under one or more green-manure crops before the plants are set. A legume such as clover, cowpeas, or some other crop adapted to the region is preferable.

Preparation of the soil may be begun one or two seasons before the strawberry plants are set. Two seasons are required for sod land, particularly where white grubs are numerous. These grubs are the larvae of May beetles or June bugs, and are frequently abundant in sod land, where the eggs are usually laid. If strawberries are planted on land heavily infested with white grubs, the grubs will eat the roots of the plants and cause much loss. Because the grubs remain in the soil in the larval stage for about two years, and because

grass roots in the sod might interfere with proper preparation of the soil, hoed crops should usually be grown on such land for two seasons after it is plowed, before strawberries are planted in it. During this time the humus content can be increased or renewed if necessary.

INJURY BY NEMAS

Directly connected with selection of a site and preparation of the soil for a strawberry plantation is the problem of the serious damage done to strawberries in the South by nemas. One nema trouble is commonly called root knot because of its effect on the roots of the plant; another is called "dwarf" because of its effect on the plant.

ROOT KNOT

The nema causing root knot is also called the "gall nema" or the "eelworm." It is one-sixtieth to one-twentieth inch in length. It penetrates the small roots of plants and causes numerous swellings or knotlike enlargements which interfere with the passage of water through the roots. (Fig. 3.) The roots may be affected seriously, however, even when no prominent enlargements can be seen.

Gall nemas are most abundant in the South, where the soil rarely or never freezes to any considerable depth. They are more injurious in sandy than in heavy soils. Strawberries are known to have been injured by this nema in the Tyler section of Texas, in the Hammond section of Louisiana, in various sections of Mississippi and Florida, in the Chadbourn section of North Carolina, in the Norfolk section of Virginia, and in other parts of the United States. Undoubtedly they will be found in still other parts of the South.

New land or land known to be free from root-knot nemas should be used for strawberries. However, such land is seldom available in the South. Because these nemas are so destructive to strawberry plants set in infested soil in the extreme South, such land must be freed from nemas as it is prepared for strawberry planting. The nemas can be eradicated in two to three years by starvation. Either the land must be kept bare of all vegetation by frequent cultivation, or no crops except those practically immune to the nema must be grown on it during this period. Nemas are able to exist in soil for more than a year even when no food plants are present, but probably can not live in such soil more than three years. However, there are practical difficulties in the way of completely controlling vegetation, and if immune or very resistant crops are grown for two or, preferably, three seasons, and no root-knot nemas are brought in on plants or tools or by other means, the field can be freed from them.

Common crops and plants known to be immune or very resistant to nemas and which may be used in rotations intended to free the soil of them are corn, sorghum, winter oats, rye, pearl millet, wheat, Iron and Brabham cowpeas, velvetbeans, peanuts, and beggarweed. Many of the most valuable crops, such as cotton, sweetpotatoes, cabbages, and many other garden vegetables, peach and fig trees, and numerous other crops widely grown in the South are so susceptible that they can not be grown on land while it is being freed from nemas.³

³ See Farmers' Bulletin 1345, entitled "Root-knot: Its Cause and Control," for further information on nemas and their control.

DWARF

In Florida and in some other sections one of the most serious diseases is called "dwarf," "crimps," "crimp plants," or "white buds." It is caused by a nema that lives in the crowns, buds, and

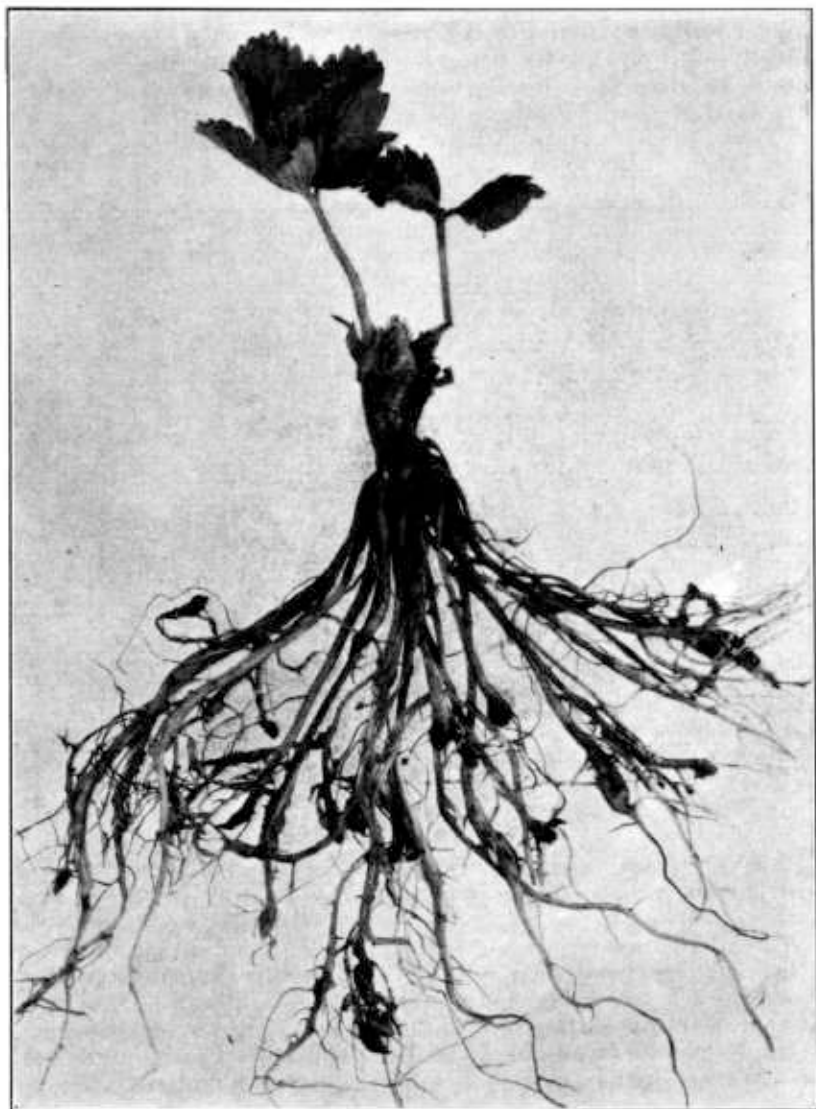


FIGURE 3.—Roots of a strawberry plant showing galls caused by the root-gall nema

leaf axils. Plants affected by it bear little or no fruit. Often no blossoms or berries are produced, though in some such cases a few imperfect berries are formed. Affected plants are recognized by a peculiar twisting and dwarfing of the central and younger leaves (fig. 4), often accompanied by a gloss and darker green of the

diseased leaves. No central bud develops in these plants, as it does in healthy plants. These symptoms appear during the period from July to September, but, except in central Florida, disappear during the winter and spring. Experienced growers are able to recognize the dwarf or crimp plants in the propagating beds and discard them. Because runners from affected plants are usually diseased, plants raised from them should be discarded. As the only known means of control is prevention by using healthy plants, all suspected plants should be discarded during setting. This disease is common in Florida, Louisiana, southern Mississippi, and North Carolina, and has been found in the Norfolk (Va.), Arkansas, and Tennessee districts.

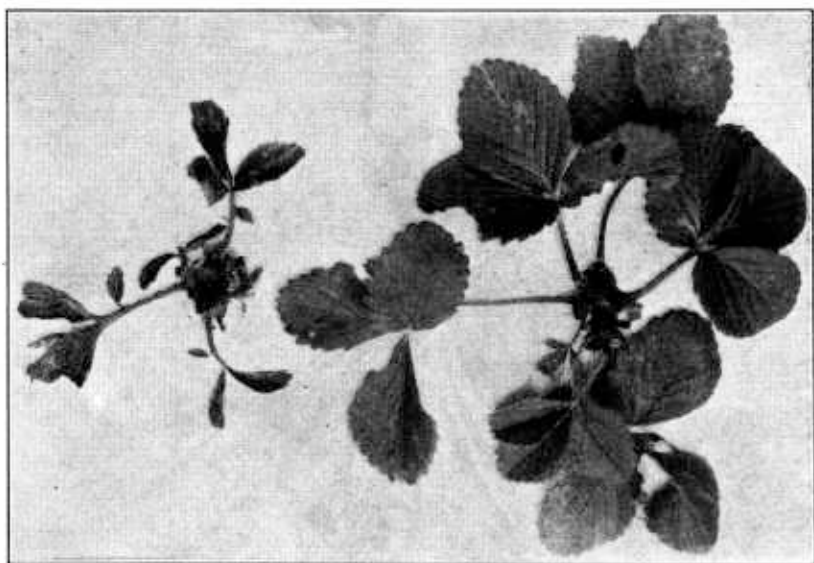


FIGURE 4.—Left, plant affected with "dwarf"; right, healthy plant

ROTATIONS

In North Carolina many growers use the following rotation: After strawberries, a nema-resistant variety of soybean or cowpea is drilled in rows; after this is turned under or harvested, winter oats are sown. In the spring the oats are plowed under or harvested, and soybeans or cowpeas planted again. After this crop is harvested or plowed under, strawberries are planted in the autumn.

Other rotations using root-knot resistant crops will be suggested by the particular needs of individual growers. Corn should not be used in the rotation, as root lice, usually very abundant after corn, do much injury to the strawberries even when the berries are planted two years after the corn. Strawberries succeed well after sweet-potatoes, but in some sections may suffer from *Rhizoctonia* root rot after potatoes, tomatoes, garden beans, or beets.

Whatever the crop or treatment of the soil before strawberries are planted, the soil should be so managed as to be in a high state of fertility and contain an abundant supply of humus at the time the

planting is done. A liberal content of humus is particularly important because of its effects upon the productiveness and moisture-holding capacity of the soil. Moreover, the soil must be put in thorough condition for planting by plowing and harrowing or such other operations necessary to pulverize it and make it mellow.



FIGURE 5.—A, This field has been plowed into ridges and is being set to strawberries. The raised beds help the drainage on wet land. (Photographed at Independence, La., November 17.) B, The strawberry plants have been set on the raised beds. In the background, piles of pine needles are seen which will be used for mulch. (Photographed at Independence, La., January 28.) C, The tops of the ridges are being leveled with a plant drag attached to a cultivator, before setting the plants. (Photographed at Mount Olive, N. C., May 28)

FINAL PREPARATION FOR PLANTING

Since, in most of the area to which this bulletin applies, the land is low and the drainage often poor, the strawberry plants are commonly set on ridges 3 to 12 inches above the furrows which separate them, as shown in Figure 5. Methods of plowing that will form suitable ridges and furnish good drainage should be employed.

The height and width of the ridges will depend on the character of the soil and on the slope of the field. Unless the conditions are

unusual, ridges 6 to 9 inches above the bottom of the furrows are sufficient. The width of the ridges, which differs greatly in different sections, is further considered under "Planting and training systems." Figure 5, A, shows the ridges thrown up and being planted. The tops of the ridges are usually leveled with a plank drag, as shown in Figure 5, C. Relatively small, narrow ridges are also shown between the wider planting ridges and in the center of what later will be the furrows. The earth from these will be thrown on the sides of the planted ridges to make them wider, as shown in Figure 5, B.

ESTABLISHING THE PLANTATION

In Florida, because of the nema and other troubles, the growers usually obtain a limited number of plants each year from northern nurseries. These plants are set during the winter, about 3 feet apart in rows about 4 feet apart, and serve as mother plants, from which the plants are secured that in due course make the fruiting plantations.

Thus fresh stock is brought annually from regions not infested with nemas and other troubles more or less prevalent in the South, which would soon become serious in the fruiting plantations if the new stock of plants was obtained year after year from local sources.

OBTAINING PARENT PLANTS FROM THE NORTH

The manner of handling the mother plants and of obtaining the stock for fruit production, together with the time of performing the various operations in Florida, is about as follows:

January to March.—New "mother plants" from northern sources are obtained and set. These should start into growth at once.

June.—By this time the mother plants set from January to March should have developed enough runner plants to set a considerable area.

August.—The runner plants from the June setting should be ready for planting a more extended area.

October and November.—In turn, the August-set plants should have developed runners. These plants are now set to form the main fruiting plantation.

The exact time of making the original planting and the several transplantings of the runner plants naturally varies with weather conditions. The months given, however, are those in which the transplanting usually is done if moisture conditions are favorable or are under control (as when an overhead sprinkling system of irrigation is used). A field set in February to be used as a propagating bed is shown in Figure 6.

Some growers prefer to leave the bed made by runners from the original plants until September and then attempt to encourage the development of vigorous runner plants to be set in the plantation and to bear fruit. This practice, however, has not been found as satisfactory as the one previously described, and the number of plants that must be brought from the North for the original planting from January to March is larger than is necessary when the transplanting is done in June.

By following the practice first discussed it is possible to obtain enough plants to set a large fruiting area from a small original stock of plants. Moreover, plants raised in Florida in this manner will have larger crowns and will bear much better than those brought from the North in October or November and set at once to fruit the

following winter. In general, growers have found the latter method unprofitable.

RAISING FRUITING PLANTS

In the Louisiana strawberry district the plants used at present are propagated from local stock. A part of the old field which has



FIGURE 6.—These strawberry plants were brought from the North and set in February. By the 1st of June they will have made a dense mat of plants that will be used to set out a larger propagating bed. The plants grown on this will be set on a still larger area in August, and these will produce the plants that will be set in the fruiting beds in October and November. (Photographed at Plant City, Fla., March 27)



FIGURE 7.—The mulch is being raked from the strawberries and stacked for use another season. The old plants have been cut out, and from the remaining ones the plants to be set in the autumn will be propagated. (Photographed at Hammond, La., June 15)

fruited is kept free from weeds, and the runner plants from this bed are set in the autumn. Figure 7 shows a field at Hammond, La., which is to be used as a propagating bed. The mulch has been raked up and the weeds and poorer plants dug out. By November a wide

bed of plants should have formed. Some of the most progressive growers transplant the runner plants in July, and from this new bed raise plants that are set later to make the fruiting plantation.

As the nema is common in Louisiana, plants not obtained from northern sources should come from fields free from this pest. Runner plants produced by plants obtained from northern sources should be set in July in order to produce additional runner plants for setting the fruiting plantation later in the season.

In some parts of Texas plants for the fruiting plantation are secured each year from northern nurseries. Growers who follow this course believe that they obtain better results than by using their home-propagated plants. In other localities plants are either propagated year after year from those locally grown or a stock is brought every few years from the North. Unless their home-grown plants are free from nemas, growers in these sections should be able to increase their yields by securing their stock from the North each year. The northern stock should be healthy and should be grown in soil free from nemas. Florida growers have found it necessary to obtain plants from as far north as Maryland, and probably would prefer to secure them from still farther north if they could be dug and shipped in the winter.

Practices suggested for securing plants for districts other than those in Florida, which are given above, are:

Norfolk and Mount Olive (N. C.) districts.—Secure plants in February and March from the North or from local fields known to be free from nemas. Use them to set permanent fields.

Chadbourn district.—Follow the above practice or set plants in February or March and raise plants to set in the fruiting plantation in August or September.

Alabama and Mississippi districts (except Bay St. Louis, Miss.).—Follow the practice suggested for the Norfolk district.

Hammond and Bay St. Louis (Miss.) districts.—Follow either the first or second method specified below:

(1) January to March: Set mother plants from the North. June 15 to July 15: Use the best of the runner plants produced by those set from January to March to set a larger area of stock plants. October to December: Use the best of the runner plants produced by those set in June or July to set the fruiting plantation.

(2) May: Cultivate and weed out the bearing field or a portion of it immediately after the picking season. June 15 to July 15: Use the best of the runner plants from above to set a new plantation for making plants. October to December: Use the best of the runner plants from the field set in June or July to set the fruiting plantation.

Houston (Tex.) district.—December to March: Secure plants from the North in sufficient quantity and set the permanent fruiting plantation.

Tyler (Tex.) district.—February to April: Follow the practice advised for the Norfolk district.

TIME OF PLANTING

In general, the planting seasons have already been indicated. Where the hill system (to be described later) is used, however, certain facts should be remembered. In Florida most of the plants from which the crop is produced are set in October. Those set in the latter part of October begin to bear earlier than those planted in September or those set in August, and growers use this characteristic to regulate the bearing season to some extent.

In the Hammond district the plants set in November are usually better than those set at other times, while those set as late as December 20 may be satisfactory. Figure 8 shows part of a field at Ham-

mond in which the rows to the left were set on December 22 and those to the right in October of the same year. Because of weather conditions which affected their growth, the plants set in October did not grow or produce as well as those set in December, and they required more tillage.

PLANTING AND TRAINING SYSTEMS

Two planting systems are generally used in the South, the hill system and the matted-row system. The map shown in Figure 1 indicates the sections in which each system is principally used.



FIGURE 8.—Strawberry plants set in single rows on slightly raised beds. The plants in the row at the right were set in October, while those in the rows at the left were set on December 22. The later-set plants were better, produced more fruit, and required less tillage. (Photographed at Hammond, La., April 14)

HILL SYSTEM

Under the hill system the plants are commonly set in late summer or in the autumn and the crop is harvested during the winter or the following spring. Usually plants set at that time make no runners, but if any do appear they are removed. When this system is used, the plants may be set in single, double, or triple rows, as shown in Figure 9, A, B, and C.

When the hill system is employed in the Chadbourn district of North Carolina, in the central Florida sections, and in the Hammond district the single row is generally used. The plants are usually set about 1 foot apart in rows 3 feet apart, as shown in Figure 9, A. Occasionally the rows are set $3\frac{1}{2}$ feet apart.

In the northern Florida section, and to some extent in others, the double-row system is preferred. In northern Florida the rows are set 20 to 24 inches apart, and an alley 2 to 3 feet wide is left between pairs of double rows, as shown in Figure 9, B. Where double rows are set in central Florida and in Louisiana, these rows are 12 to 15 inches apart and the alleys 3 to 4 feet wide. The wider beds on

which two rows are set allows more plants to the acre and more of the field is in beds than when single rows are used.

Except in the Starke section of Florida, triple rows are rarely used. There three rows are often set 20 to 24 inches apart on each bed. If the drainage is good, this plan may be used. One very successful grower in Louisiana sets his plants in triple rows with the plants 12 to 14 inches apart each way. His plan is illustrated in Figure 9, C.

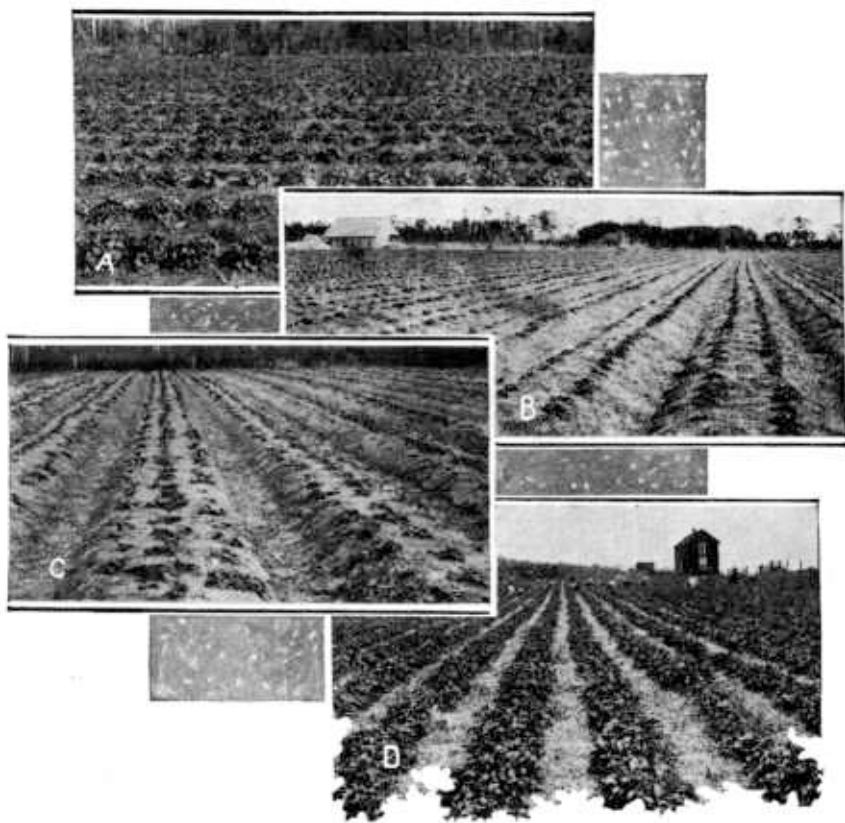


FIGURE 9.—A, Strawberry plants trained to the hill system. The plants were set 1 foot apart in single rows $2\frac{1}{2}$ to 3 feet apart. All runners were kept off. (Photographed at Plant City, Fla., February 3.) B, Strawberry plants set in two rows on each raised bed. The plants are 14 inches apart in the rows, which are 22 inches apart. The alleys between the beds are 32 inches wide. (Photographed at Starke, Fla., February 6.) C, Strawberry plants set in three rows on each raised bed. This plan is rarely followed except in the Starke, Fla., region, though occasionally elsewhere. (Photographed at Hammond, La., November 22.) D, Strawberries in matted rows, well grown, and mulched with straw. Under this system plants are set commonly in winter or early spring 18 to 40 inches apart in rows $3\frac{1}{2}$ feet distant. The runners are allowed to root.

MATTED-ROW SYSTEM

Under the matted-row system the plants are usually set in the winter or early spring, 18 to 40 inches apart in rows $3\frac{1}{2}$ to 6 feet apart, and the runners are allowed to root. The interval at which the plants should be set in the row depends upon the probable danger of losing plants through drought or insects. If there is little danger, the plants may be set 40 inches or more apart, and runner plants may

be trained to form a solid mat in the spaces between plants. Where loss is likely, the plants should be set about 18 inches apart.

The matted-row system is commonly used in the Norfolk district, the Wallace and Chadbourn districts in North Carolina, in Alabama, in all the Mississippi districts except Bay St. Louis, and in the Houston and Tyler districts of Texas. Figure 9, D, shows a field grown under the matted-row system.

NUMBER OF PLANTS REQUIRED TO SET AN ACRE

Table 1 shows the number of strawberry plants needed to set an acre of ground when spaced according to the systems commonly used.

TABLE 1.—Number of strawberry plants required to set an acre of ground when spaced at different distances apart

Distance apart	Plants to the acre	Distance apart	Plants to the acre
2 by 1 foot.....	21,780	2½ by 1½ feet.....	11,616
2 by 1½ feet.....	14,520	3 by 2 feet.....	7,260
3 by 1 foot.....	14,520	3 by 3 feet.....	4,840
3½ by 1 foot.....	12,446	3 by 4 feet.....	3,630

Where there is little danger of loss of plants, only the number specified above will be needed. If there is considerable danger of loss, a somewhat larger number should be obtained, in order to insure a full stand, as the expense of irrigating and caring for a field which has many blank spaces will be out of proportion to the value of the crop obtained.

CARE OF PLANTS BEFORE SETTING

Good plants in bundles of about 25 each as they are received from the nursery are shown in Figure 10. They



FIGURE 10.—Good Klondike and Dunlap strawberry plants, in bundles as they are commonly received from the nursery, showing the difference in root growth of these two varieties. Each bundle is supposed to contain 25 plants

should be kept cool and moist until set. If they are to be set the day they are received or the following day, they should be placed in the shade and covered with wet burlap. If, however, they can not

be set for several days, the bundles should be opened and the plants separated and heeled in, as shown in Figure 11.

The plants should not be dropped far ahead of the setters, especially on dry, windy days, and the workers dropping the plants should use some means of protecting their supply, as shown in Figure 12.

SETTING THE PLANTS

Plants may be set by hand, with one of several hand tools, or with a machine. For planting large areas a planting machine is cheapest



FIGURE 11.—A, Heeling in strawberry plants. The bundles are opened and the plants spread out in a trench with the crowns even with the surface, as here shown. B, The trench in which the plants have been placed, as shown in A, has been filled with moist soil covering the roots, and the soil is being packed firmly about them. Here they are left until wanted for setting in the field.

and best. Whatever the method used, two things are of special importance—setting the plants at the right depth and making the soil very firm about the roots.

The plants should be set so that the crowns are even with the surface of the ground after the soil has been packed about the roots. The proper depth for planting is illustrated in Figure 13.

If the soil is not properly firmed about them, air gets to the roots, and they are likely to dry out. Besides, plants so treated usually will start a feeble growth or none at all. If the soil is thoroughly firmed very little trouble will be experienced in getting plants to live. Some growers step on each plant after it has been set, in order to make sure that the soil has been properly firmed. When this is done, the instep should come over the crown of the plant in order to avoid injuring it.

SETTING BY HAND

Setting by hand is not often done except in very loose soils, but in such soils this method is very satisfactory. A wedge-shaped opening about 4 inches deep is made in the soil with one hand and the roots inserted with the other. The earth is then drawn about the roots and firmed. Plants may be set quite rapidly in this manner, but the work is hard and the soil seldom sufficiently mellow. The method is used chiefly in sections where the plants are set close together and those setting them do not have to move about much.



FIGURE 12.—Dropping strawberry plants from a fertilizer sack. A slit is cut for the head near the top and one across the outer side near the center. The plants are placed in the bottom where they are protected from sun and wind



FIGURE 13.—Strawberry plants set at different depths. The plant at the left is set too deep and will be smothered; the one in the center, with crown at the surface, is right; the one at the right is too shallow and will dry out

SETTING WITH HAND TOOLS

Growers in most districts use a dibble, trowel, or punch to make openings in the soil for setting strawberry plants. Different sorts of such tools used for this purpose are shown in Figure 14. With one of these implements an opening 4 to 6 inches deep is made in the soil, the roots are inserted, and the earth pressed back firmly about them. When a punch is used one man usually goes ahead making the holes, another follows dropping the plants, and one or two others

place the plants in the holes and draw the earth about them. The punch can not be used readily in soils having straw or stones in them, but is well adapted for use in loose soils. The dibble can be used in any well-prepared soil.

Two men form a crew for setting plants with a spade. One inserts the spade and opens a hole by forcing it forward. After the roots of the plant have been inserted, he withdraws the spade and with his foot presses the soil firmly about the roots. The second man carries the plants and inserts them in the holes as they are made with the spade. Plants can be set rapidly by this method, which is widely used.

A paddle like that shown in Figure 15,

A, is often used. The plants are dropped exactly where they are to be set, and a man following presses the roots into the ground with the paddle and thoroughly packs the earth about the roots with his foot. Plants can be set very rapidly by this method, but the soil must be loose and friable. A variation of this tool, called a "packer," is shown in Figure 15, B. The plant is pressed into the ground with a paddle and the earth firmed around it with the packer.

Another method of planting is with a punch and tongs, as shown in Figure 15, C. This method is used more extensively in setting

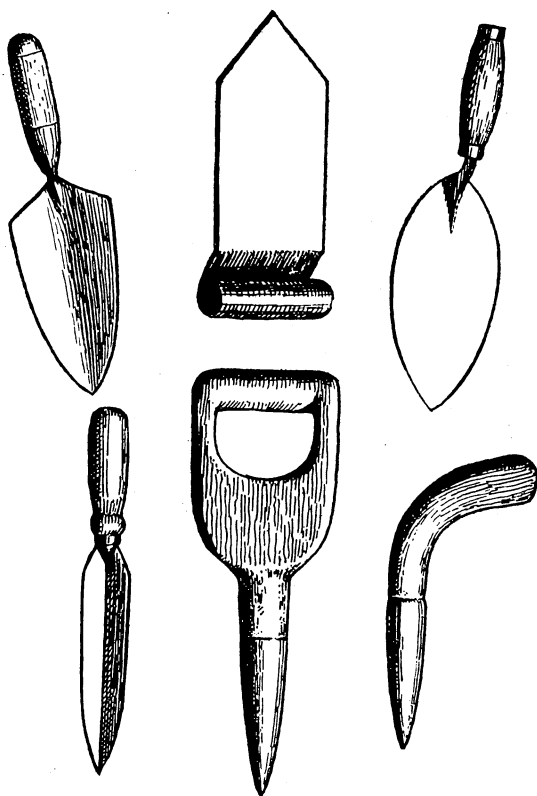


FIGURE 14.—Different types of dibbles, trowels, and punches commonly used in transplanting strawberries. The best for most conditions is shown in the center of the top row



FIGURE 15.—A, Setting a strawberry plant with a paddle. This method is adapted to places where the soil is very mellow. The plants are dropped in place, the roots forced into the ground with the steel-tipped paddle, and the soil is then firmed about them with the foot. B, Setting a strawberry plant with a packer. The roots of the plant are forced into the ground with the paddle, and the soil is firmed about them with the packer which is attached to the handle of the paddle by clips which allow it to be worked up and down. C, Setting a strawberry plant with punch and tongs. A hole is made with the punch, the roots of the plant placed in it with the tongs, and the soil firmed about them with the foot.

sweetpotatoes than for strawberries. A hole is made with the punch, the plant is picked up with the tongs and placed in the hole, and the earth firmed with the foot. A man experienced in the use of this tool can set 10,000 plants a day with it, while an expert can set many more. Under favorable soil conditions it is easier to set 10,000 plants a day in this way than to set 5,000 with a dibble or trowel.

SETTING WITH MACHINE

On smooth land planting machines used in trucking sections for transplanting tobacco, tomatoes, cabbages, sweetpotatoes, and the like are often used to set strawberry plants. The soil should be moist or water must be applied when the plants are set with a machine. Usually one man drives the machine and two others feed plants into it. A fourth man prepares the plants for the machine. About 30,000 plants a day, or 3 to 5 acres, can be set in this way.

The chief difficulty in the use of a planting machine is that it is difficult to set all the plants at the right depth. After some practice, however, intelligent droppers become so expert that practically all plants are set at the proper depth with the roots straight down and are set better than by hand. A roller attached to the planter may be used to firm the soil, or a man may walk along the rows and firm the plants with his foot. When all conditions are favorable, especially in sections where cool, moist weather may be depended upon for some time after the plants have been set, such a machine may be used very successfully, and the cost of planting will be comparatively low.

CARE OF THE PLANTS AFTER SETTING

REMOVING FLOWER STEMS

Flower stems usually appear on winter or spring set plants soon after they are set. Until the plants become firmly established after transplanting, fruit production is a severe drain on their vitality. Therefore, if the plants do not start well, or if the season is dry, the flower stems should be removed as they appear. Furthermore, when a very large number of plants is needed, the flower stems should be removed, since the runners will increase more rapidly and better plants will be produced than if fruit is allowed to develop. When the plants are thoroughly established in the soil, and an especially large number of runner plants is not needed, the flower stems need not be cut off.

WIDTH OF ROWS

In general, matted rows should not be more than 24 inches wide, and many growers find that 12 to 15 inches is better than a greater width. It is easier to harvest the berries from narrow rows, and some varieties of strawberries, such as the Blakemore, produce better in narrow rows. If the row is more than 2 feet wide, some ripe berries along the center are likely to be overlooked by the pickers, and unless the plants are well spaced many berries are likely to be small. Except in the Norfolk district, where rows 3, 4, and even 5 feet wide are sometimes made, matted rows are ordinarily less than 2 feet wide.

THINNING THE PLANTS

It will often be necessary to thin the plants in matted rows during the summer and autumn. For this purpose, roller cutters may be attached to the cultivator, so that all runners extending more than a certain distance into the alleys will be cut off when the cultivating is done. Surplus runners may also be removed when the field is hoed.

Where the matted row is 2 feet in width, growers, in addition to attaching cutters to the cultivator, sometimes run a bull-tongue plow with a point about 4 or 5 inches wide down the center of each row, tearing up the center plants. This leaves the row cut into two parts in what might be called a double-matted row. Another method sometimes followed is to run a spike-tooth harrow across the rows in late summer or autumn. The teeth should slant backward, so that only the plants which are not thoroughly rooted will be torn up. This method should be employed only after careful trial, as there sometimes is danger that it will loosen too many plants.

SPACING THE PLANTS

Under the more intensive systems of culture, such as may be used in a home garden and in growing fancy berries, the runner plants may be spaced by hand rather than allowed to root at will. Where this is to be done, as soon as the tips of the first runners begin to enlarge, they should be placed in the rows between the mother plants and covered with soil. The next ones should be placed the length of one runner out from the original row and on each side of it. Additional runners may then be rooted until a wide row has been formed, with the plants at least 6 inches apart. Thereafter, all runners should be cut off as they develop. Sometimes it will be found cheaper to allow the runner plants to root at will until the middle of August. Then all superfluous plants are dug out and the remainder spaced at equal distances.

TILLAGE

In the Florida districts it is necessary to keep down weeds and maintain the soil in good physical condition until the mulch is put on, which in the central Florida district is usually some time in December and in the Starke district in January or February. One-horse cultivators and hoes are used largely in cultivation before the mulch is applied, but hoes only after the mulching is done.

In the Louisiana district weeds should be kept down and the soil maintained in good tilth by hoeing and cultivating until cold weather sets in. As certain weeds grow vigorously throughout the winter, much hoeing is necessary during that period. The weeds must be scraped from around the plants, as shown in Figure 16. At this time or as soon afterwards as possible, a horse cultivator should be run in the alleys. If weeds continue to grow, the alleys should be hoed or a shallow cultivation given. Great care should be taken to keep the alleys open, so that water may drain off freely and the strawberry roots be disturbed as little as possible. In this district the mulch is usually applied during February. If weeds develop after this time they should be kept down with a hoe.

In sections other than those in Florida and Louisiana tillage should begin immediately after planting and continue each week or 10 days until late autumn or into the winter when the mulch is applied. This late tillage will keep down the weeds, so that little or no hoeing will be necessary in the spring.



FIGURE 16.—A common practice in southern Louisiana is to hoe or "scrape" the weeds from the rows of plants into the middles. This is done late in January or in February and pine-straw (needles) mulch is then applied. (Photographed at Independence, La., January 29)

COMPANION CROPPING

In order to secure returns from the land during the first summer after spring planting of strawberries, vegetables are frequently grown along the rows or in the alleys between them as companion crops to the strawberries. This practice is followed especially where the matted-row system is used.

Nearly all kinds of vegetables may be raised in this way, and the thorough cultivation given them will be sufficient for the strawberry plants. Most vegetables, however, are susceptible to root-knot nemas, and care should be used to see that infested plants are not set in the strawberry plantation. Vegetable seeds do not commonly carry nemas.

Onions may be grown in the strawberry rows, as shown in Figure 17, A, while such quick-maturing plants as lettuce, radishes, peas, and carrots may be grown between the rows, as shown in Figure 17, B. The strawberry rows are planted the same distance apart as under ordinary conditions. The vegetables are removed before the strawberry plants begin to spread over the ground to any extent.

When such crops as beans, peas, and cabbage are grown with strawberries, special systems of planting the vegetables are often used. Cabbage or cauliflower may be set about 6 inches to one side of the strawberry row. The strawberry plants will be shaded to some extent by the leaves of the cabbage or cauliflower, but when the vegetables are removed during the summer the strawberries will spread over and occupy the whole space.

When beans are used as a companion crop, the strawberry rows are usually set somewhat farther apart than in ordinary practice and the companion crop planted in the middle of the alleys between the rows. The strawberry rows should be spaced at least 4 or 4½ feet apart and only a narrow mat of plants allowed to form until after the beans are harvested. Potatoes or corn should not be used as companion or preceding crops because of danger of loss from *Rhizoctonia* and verticillium wilt and from root aphids, respectively.

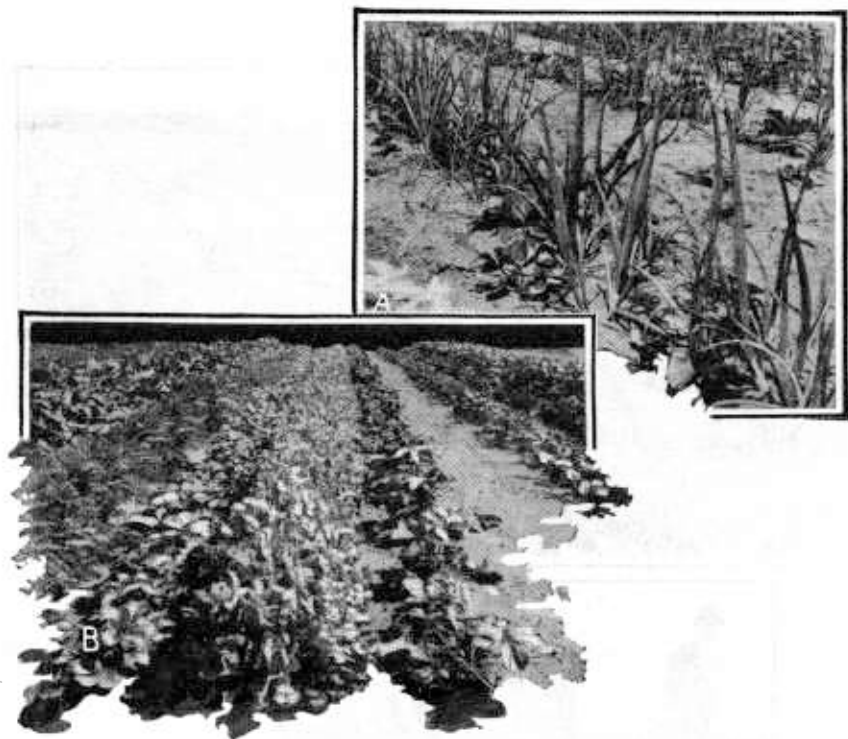


FIGURE 17.—A, Strawberries with onions as a companion crop in the rows. The onion sets are planted in the spring and removed early in the summer, leaving all the space for the strawberries. B, Strawberries with companion crops between the rows. At the left, lettuce, carrots, and beets alternate with the rows of strawberries, while radishes have been harvested at the right, and beans are growing at the extreme right. The extra fertilizer and careful culture given these companion crops are an advantage to the strawberry plants

STRAWBERRIES AS AN INTERCROP

In many sections, strawberries are grown as an intercrop in peach, apple, fig, orange, or other tree-fruit orchards. When the orchard is first planted, strawberries may be set out and grown for several years before the trees will need all the ground. When this practice is followed, the strawberries should furnish some income from the land or at least pay the expense of caring for the orchard. The intensive cultivation given strawberries is especially good for young orchards, and as strawberries will not bear well unless the moisture conditions are good, they may prove a good indicator of these conditions.

MULCHING

A mulch is used commonly in strawberry fields; its principal advantages are that it keeps the berries clean, conserves moisture, and helps to keep down weeds. The mulching materials most commonly used in the South are pine needles, wild hay, and wheat, rye, and oat straw; all are satisfactory. When pine needles are used they are raked during the winter and are usually stacked along one side or on both sides of the field.



FIGURE 18.—A, The strawberry field shown in D when partly mulched. This shows how the straw was thrown off the wagon in windrows and then scattered over the rows. B, Strawberries mulched heavily, not only serving to conserve moisture and to keep the fruit clean, but the extra mulch between the rows may be used to cover the plants to protect the blossoms from late frosts. (Photographed at Starke, Fla., March 29.) C, Scattering mulch by hand over the strawberry field. This method involves more labor than that shown in D. (Photographed at Starke, Fla., February 6.) D, Mulching the strawberry field with wheat straw thrown from a wagon. This method is more rapid and less laborious than handwork. E, A handcart for scattering mulching material over a field of strawberries.

In nearly all parts of the South the mulch is applied just before the blossoms open. Where the hill system is followed the mulch is distributed over the fields by hand from a handcart, as shown in Figure 18, E, or from a rack, as shown in Figure 18, C. Where the

matted-row system of culture is used the mulch is generally placed in windrows and spread by hand, as shown in Figure 18, A and D.

Sufficient mulch should be applied so that after settling it will be 1 to 3 inches deep. This will require several large 2-horse hayracks of material to the acre.

In the central Florida district, the mulch is used not so much to keep the berries clean as to protect the flowers and fruit from frosts. In this district the mulch is put in the alleys and when there is danger of frosts it is spread over the plants. A small quantity of pine needles, wild hay, or straw will afford protection from ordinary frosts, though the temperature over a mulched field is lower, other things being the same, than over an unmulched field. In the Starke district of Florida, strawberry fields are mulched to keep the berries clean as well as to protect the plants from frost. (Fig. 18, B.)

Where a mulch has been used, some of the berries are likely to be lost through cricket injury at the beginning of the strawberry season. The crickets hide in the mulch by day and at night eat the ripening fruit. Unless partly eaten berries are picked, they rot and spread disease to neighboring berries. The damage done by crickets is not often serious, and may be largely prevented by scattering along the rows poisoned bran mash made by mixing 1 pound of white arsenic and 12 pounds of bran in water.

USE OF GREEN-MANURE CROPS

Green-manure crops are those grown to enrich the soil and particularly to increase the humus and the moisture-holding capacity. In the South, good crops of strawberries depend very largely on an ample humus supply. When the supply is adequate, the plants grow better, and drought does not affect them as quickly as when it is deficient. Oats, rye, Iron, Victor, and Brabham cowpeas, velvetbeans, and crabgrass are extensively used as green-manure crops. Winter oats (or winter rye) and cowpeas if turned under, as in the North Carolina rotation previously mentioned (p. 6), should furnish sufficient humus unless the soil is seriously deficient when the plants are set.

In some sections the strawberries occupy the ground only during the winter and early spring, being plowed under in the spring after the crop is harvested. A green-manure crop or corn with cowpeas between the rows may then be planted. The green-manure crop is plowed under or the corn harvested and the cowpeas plowed under before the field is reset to strawberries in the autumn. The use of corn immediately preceding strawberries is not recommended because it favors the increase of root aphids. The cowpeas should be of the Iron, Brabham, or other nema-resistant varieties. Where a field is to be renewed without resetting the plants, green-manure crops may be sown between the strawberry rows during certain periods and later worked into the soil.

USE OF FERTILIZERS AND LIME

The use of fertilizers and lime on strawberry fields is governed largely by the same principles that apply to their use on other crops. As soils differ greatly in their composition the problem of fertilizers is chiefly local, to be solved by each grower according to his own

conditions. Proper fertilizer utilization can be determined by applying the different plant foods (nitrogen, phosphoric acid, and potash) separately, in different combinations and in different quantities, to small plots and keeping records of the yields from the different plots. In like manner different quantities of stable manure can be applied to different plots in order to test its value.

A good crop of strawberries will remove considerable plant food from the soil. Excepting coarse sandy soils of the Southern States, however, most soils are so well supplied with plant food that large crops of strawberries can be produced without applying fertilizers, provided the physical condition of the soil is good. If, therefore, the soil is kept in a satisfactory condition by the addition of humus, by adequate drainage, and by frequent tillage, and if the moisture supply is ample, many strawberry fields will need no fertilizer or stable manure. In many localities, however, the use of fertilizers has been found profitable, and in such areas growers should determine the kind and quantity necessary for their conditions in the manner suggested above.

Under the hill system of culture, the fertilizer, when applied, is usually scattered along the rows, and the soil thrown on top before the plants are set. Some growers, however, use only part of the fertilizer at that time, applying the remainder after the plants have become well established. In the district about Houston, Tex., ordinarily no fertilizer is used under any system of training. In other districts where the matted row is used, fertilizer is sometimes applied just before the plants are set, sometimes after growth has started, and sometimes in the autumn.

Investigations in North Carolina indicate that nitrogen is the element most important in fertilizers applied to strawberries. The best source of nitrogen and the best time, method, and amount of fertilizer applications are not completely understood. Results so far obtained indicate that the strawberry plants need available nitrogen from early in September until the end of the next spring crop. Because of the difference in availability of nitrogen in different fertilizers, the source of the nitrogen is of great importance. Nitrogen from mineral sources, such as sulphate of ammonia and nitrate of soda, is quickly available, while that from organic sources, such as cottonseed meal, tankage, fish meal, and Peruvian guano, is available more slowly. It would appear that a fertilizer with a content of 3 to 5 per cent nitrogen, part of which is from mineral sources and part from organic sources, would be satisfactory. Because it is dissolved quickly and may be leached out in a short time, if inorganic or mineral nitrogen only is used, best results would be secured from several applications. Sulphate of ammonia tends to make the soil more acid and should not be used if the soil is inclined to be too acid.

Since potash and phosphorus applied as a top-dressing do not move down into the soil to an appreciable extent and, consequently, do not become fully available to the plant, when a mixed fertilizer is applied it should be placed down beside the roots along the sides of the rows after turning a shallow furrow away from the plants. Nitrogen, on the other hand, readily goes down into the soil and if nitrogen only is used a top-dressing is very satisfactory.

In the investigations in North Carolina little increased yield has resulted from using potash and phosphate in addition to the nitrogen. During two years with hot, drying weather, potash applications have appeared to make the foliage of plants stand up much better than the foliage that did not receive potash but that did receive mineral nitrogen. In one season berries treated with phosphorus in addition to nitrogen were much better flavored than those treated with nitrogen only, while berries treated with potash were poorer flavored. There was no real evidence that potash or phosphorus tended to make the berries firmer or to increase the crop. In experiments in Arkansas and Texas, however, increased yields have been secured by the use of phosphorus.

Insufficient nitrogen in the soil results in small crops, and the berries mature much later. Too much nitrogen may make the foliage dense and the berries late in maturing. Very dense foliage and resultant shading may make the fruit somewhat more likely to rot.

Until more is known about the fertilizer requirements of strawberries it is suggested that a fertilizer with an analysis of about 3 to 5 per cent nitrogen, 6 per cent phosphorus, and 2 per cent potash be used. Experiments made so far indicate that at least half of the nitrogen should be from organic sources. For average conditions in eastern North Carolina an application of 750 pounds per acre early in September and another 750 pounds in December or early in January should be made, or a top-dressing of about 250 pounds of nitrogen only should be made in the late fall, after the early fall application of the complete fertilizer.

Ordinarily, lime should not be used, as it is injurious to the roots of strawberries. Sometimes, when the soil is in poor physical condition or extremely acid, the use of lime may pay, but in such cases it is better to apply the lime before growing cowpeas and not just before the strawberries are set or while the strawberry plants occupy the land. In many fields the lime has injured the plants and caused small, poorly flavored berries. When used, lime should always be plowed under, as otherwise it may not penetrate far into the soil.

IRRIGATING

Droughts during the long growing season occur so often and the loss from drought is so often serious that frequently it will pay to irrigate strawberries. Many growers have done so. Either the overhead sprinkling* or the surface system may be used, according to local conditions. At present, the sprinkling system is most often used in Florida, and surface irrigation in Louisiana and Texas. The sprinkling system is expensive to install, costing \$100 to \$250 per acre or even more, but once installed it is easy to operate. It is especially valuable in Florida for propagating plants.

Water for surface irrigation is usually secured in the Hammond district of Louisiana from artesian wells and in the Houston district in Texas by pumping from bayous, streams, and lakes. An artesian well provides a continuous water supply, and after the well is bored the only cost is in distributing the water in the field. Irrigation is used in summer, when drought occurs, in order to save the propagat-

* See Farmers' Bulletin 1529, Spray Irrigation in the Eastern States.

ing beds; at planting time it is frequently applied to moisten the soil for setting; and again during the fruiting season in order to counteract drought.

When the water is being applied in surface irrigation the alleys should be free from obstacles. The rows should be not more than 500 feet long and preferably not over 300 feet, so that the water can run down the alleys without too great loss. During the planting and picking seasons water should be run down every other alley, as shown in Figure 19, so that the workers may walk in the unirrigated

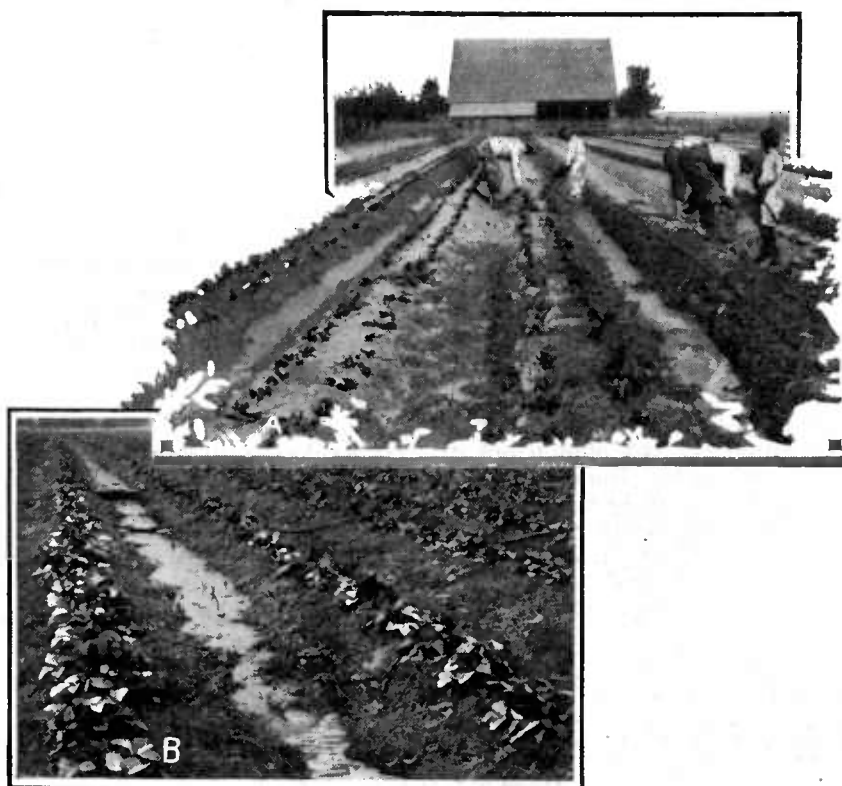


FIGURE 19.—A, Setting strawberries under irrigation. Water is run down every other alley, leaving the alternate ones dry for the convenience of those who are setting the plants. Note that double rows are set on the ridges. (Photographed at Hammond, La., November 21.) B, Strawberries being irrigated during the picking season. Water is run down each alternate alley, leaving dry spaces for the pickers. (Photographed at Ponchatoula, La., April 13)

furrows. At the next irrigation the alleys previously omitted should be watered, thus alternating at each application. The water should not be allowed to touch the leaves as, under a bright sun, foliage that has been wet will "scald" and die. Wherever possible, the irrigated alleys should be cultivated about two days after each irrigation, if the soil is in suitable condition for working.

In the Houston district the expense of installing and keeping up pumping stations is considerable. Furthermore, there is no season when heavy rains may not be expected, and if an irrigation is fol-

lowed by heavy rains, the plants may suffer severely. For these reasons, irrigation is used somewhat less than it was formerly; but as severe droughts are common many growers have found some irrigation necessary, and it is used more or less in the summer, at planting time, and at the harvest season, the last especially as an aid in keeping up the size of the fruit as harvesting progresses.

RENEWING THE PLANTATION

Where the hill system is used, the plantation is rarely renewed, but is plowed up at the end of the first fruiting season. The cost of renewing under the matted-row system is usually less than that of setting and caring for a new plantation. Therefore, where the matted-row system is used, the fields are kept from two to five or six years, or as long as they produce profitable crops. The length of time a plantation may be kept profitably depends upon the quantity of humus in the soil and upon the prevalence of diseases and weeds. If green-manure crops were turned under before the plantation was set so that the soil is in good condition, two or more crops may be harvested before the plantation should be plowed up and a new one set, but if insects, nemas, or diseases do much injury, the field may become unprofitable even though the humus supply is ample. Furthermore, if a field becomes very weedy, it may be more profitable to use the land for some other crop than to keep it in strawberries. Local conditions, therefore, largely govern the length of time a field may be profitable.

In renewing a plantation the field should first be cut over with a mowing machine. Where the growing season is long, as in the South, the mowing may be delayed several weeks after the picking season, unless it is desirable to burn over the field to destroy weevils. In that case the mowing and burning should be done immediately after the crop is harvested. In all sections where renewing is done the aim should be to obtain large, vigorous plants by October, during which month fruit-bud formation begins in much of the South.

If injuries from diseases and insects are not serious, the foliage and mulch should generally be turned under. This will increase the humus content of the soil, and put it in better condition than burning. If the mulch is very heavy, however, it may be necessary to remove part of it before plowing. If it is not too much decayed, the mulch is sometimes raked up and stacked for use the following year, and only the strawberry foliage is plowed under.

Where insects and leaf-spot diseases are prevalent, growers prefer to burn the foliage and mulch in the field. It is then easier to thin the plants and narrow the rows than if the mulch and leaves are left. As soon as the foliage has dried, the mulch should be raked on top of the rows, and when a good breeze is blowing in the direction the rows run, a fire should be started on the windward side. When burning is done in this way, the fire will pass quickly, and the roots and crowns of the plants are not likely to be injured. The foliage should not be burned, however, when the ground is very dry or when the mulch and leaves are damp.

When renewing a plantation it is desirable to reduce the number of plants in the matted row so that new runner plants will have a better chance to develop. The amount of thinning necessary will

depend upon the variety and to some extent upon the season and the soil. If the variety is one that will make a large number of runner plants later in the year, the row should be reduced to 6 or 8 inches in width, and the plants in this row thinned to at least 10 inches apart. If the variety does not make many plants in late summer and autumn, the row should be left 12 to 15 inches wide and the plants about 10 inches apart.

To reduce the width of the row, either one side or part of both sides of each row should be plowed. Usually it is best to plow one entire side of the row and also the old plants in the middle. This will leave only the younger plants on one side. The remaining plants are then thinned by running a spike-tooth harrow or cultivator across the rows once or twice and then once down the row. The weaker plants are torn up by this process, and the ridges made by plowing up one side of the row are leveled. A hoe may be used in further thinning the plants if they are still too thick. The crowns of the plants that are left are usually covered with an inch or two of soil. Within two or three weeks under favorable conditions, the plants will have sent out new foliage, and the field will have the appearance of a young plantation.

In many districts the rows are moved by plowing up one side of each row one year and having the remaining plants set runners in the alleys. The other half of the old row is plowed up the following year when the plantation is renewed, so that by the third year the rows run where the alleys were at first.

If the narrow matted-row system has been used, it may be necessary to reduce the width of the rows very little, if at all. A shovel cultivator may then be used to plow across the rows, leaving the plants in small clumps about 24 inches apart. Later in the summer the runners will fill the spaces thus plowed and make continuous matted rows by winter.

HARVESTING AND SHIPPING⁵

After berries of the best grade are grown they must be handled with great care if they are to reach the market in the best condition. The field should be picked over at least every other day, and at the height of the season it will often be necessary to pick daily. No ripe berries should be left, since at the next picking they will be too soft to ship. One soft berry in a basket may spoil the entire contents, and one spoiled basket of berries may spoil the looks of the crate by the time it reaches the market. The habit of growth of the foliage and the differences in growth of different varieties make it more difficult to pick clean in some sections than in others. The way in which dense foliage may hide the berries is shown in Figure 20, B, in contrast to the more open habit of growth shown in Figure 20, A. In picking, the stem should be pinched off, leaving about half an inch attached to the berry. Each berry should be placed carefully (not thrown or dropped) in the basket. Baskets of berries should never be left in the sun, but should be taken to the packing shed or placed in the shade as soon as possible after the fruit is picked.

⁵ See also Farmers' Bulletin 1560, entitled "Preparing Strawberries for Market."

PICKERS AND PICKING

Pickers are paid from 1 to 2 cents a quart for gathering the berries. The wage differs with the section, with the grade of work done, and with the plan of management. Thus, in one district pickers are paid 6 cents a gallon, and if they stay until the end of the season, they are given another cent for each gallon picked during the season. This system serves to hold the pickers through the latter part of the season, when the berries are smaller and less plentiful. In another section some growers pay the best pickers one-half cent a quart more than they pay untrained and poor pickers.



FIGURE 20.—A. Strawberry plants which were set in September, showing the open habit of growth as compared with those shown in B and C. These berries are much easier to pick than where they are concealed, as in B. (Photographed at Chadbourn, N. C., May 3.) B. A Klondike strawberry plant, showing the heavy foliage which hides the berries. This makes picking difficult. C. The same strawberry plant shown in B, but with some leaves removed, showing the berries

They consider that the extra pay encourages careful work and that the berries are worth more when handled by the best pickers.

The number of pickers to the acre varies greatly. Where the yields are small two are sufficient. On the other hand, 8 or 10 are sometimes needed in the height of the season on the best fields. On a field yielding 100 crates (24-quart) to the acre, four pickers working every day should take care of the crop.



FIGURE 21.—A, A pony refrigerator which is used to ship strawberries from Florida to northern markets. Two sizes are used, 60 and 80 quart. The ice pan which fits in the top is shown at the right. The tight-fitting cover is at the left. B, The strawberry shipping crates shown hold 24 quart baskets each. They are cheaply constructed and sometimes are called gift crates, because they are not returned to the shippers. The covers are nailed on. Two types of carriers used by pickers are shown in B. C, A 32-quart crate of better construction than those shown in B. The cover is hinged, with a catch fastener in front. These crates are usually returned to the shippers.

In a field that is given good attention there should be very few berries that are not of the best market grade. From some fields almost perfect berries have been secured, and no sorting after picking has been necessary. To secure crops of such fruit, however, the plants should be properly spaced in the row, the field must be free from weeds and grass, and the mulch and the humus in the soil must be sufficient to maintain an adequate supply of moisture while the berries are growing and ripening.

CARRIERS AND CRATES

Carriers holding six 1-quart baskets are used in picking in most districts in the South Atlantic and Gulf States. Two types of car-

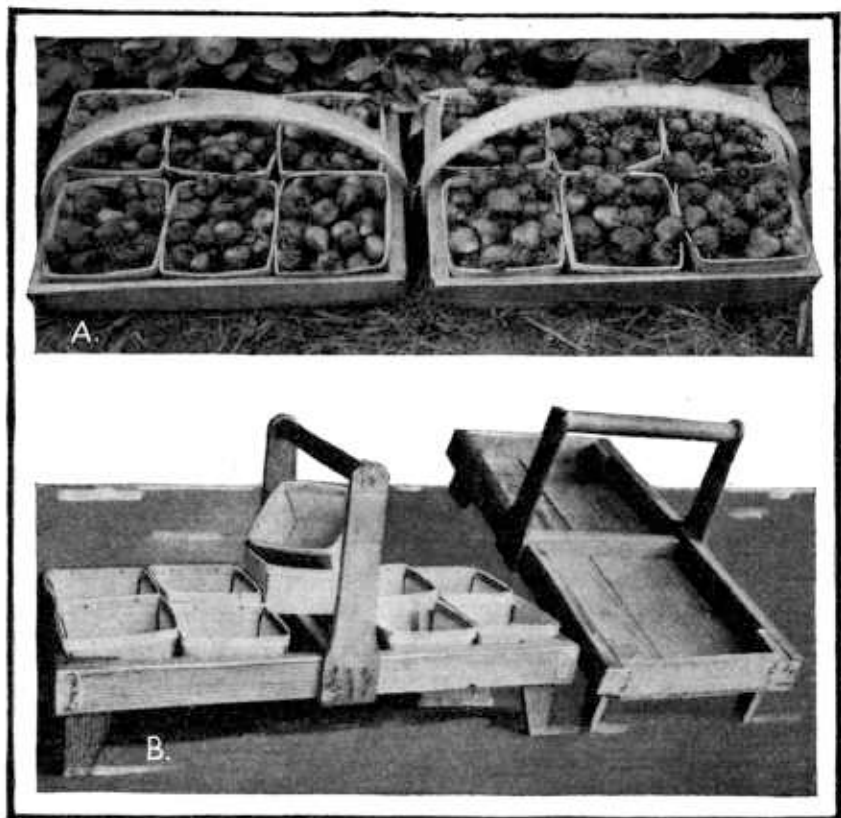


FIGURE 22.—A, Two 6-quart carriers, commonly used in picking berries. B, Two 10-quart carriers used to carry strawberries from the field to the packing house

riers in common use are shown in Figure 21, B. The carrier shown in Figure 22, A, is cheaply constructed and very convenient. Field carriers are shown in Figure 22, B.

The crate shown in Figure 21, B, is in common use in Alabama, Mississippi, and Texas. It holds twenty-four 1-quart baskets and is not usually returned to the grower when emptied. A somewhat similar type of crate holding either 24 pints or 24 quarts is used in

Louisiana, and to a slight extent in Texas. The 32-quart crate shown in Figure 21, C, is commonly used along the Atlantic coast, although in the Norfolk district in Virginia a 60-quart crate is also used. The pony refrigerator shown in Figure 21, A, is used largely in the central-Florida district. It is made in two sizes, holds 64 or 80 quarts of berries, and has, either at the top or in the center, a metal tray filled with ice. A plan for a good type of packing house, typical of those much used in the South, is shown in Figure 23.

SUITABLE STRAWBERRY VARIETIES

Only two varieties of strawberries, the Klondike and the Missionary, are grown extensively throughout the whole area to which this

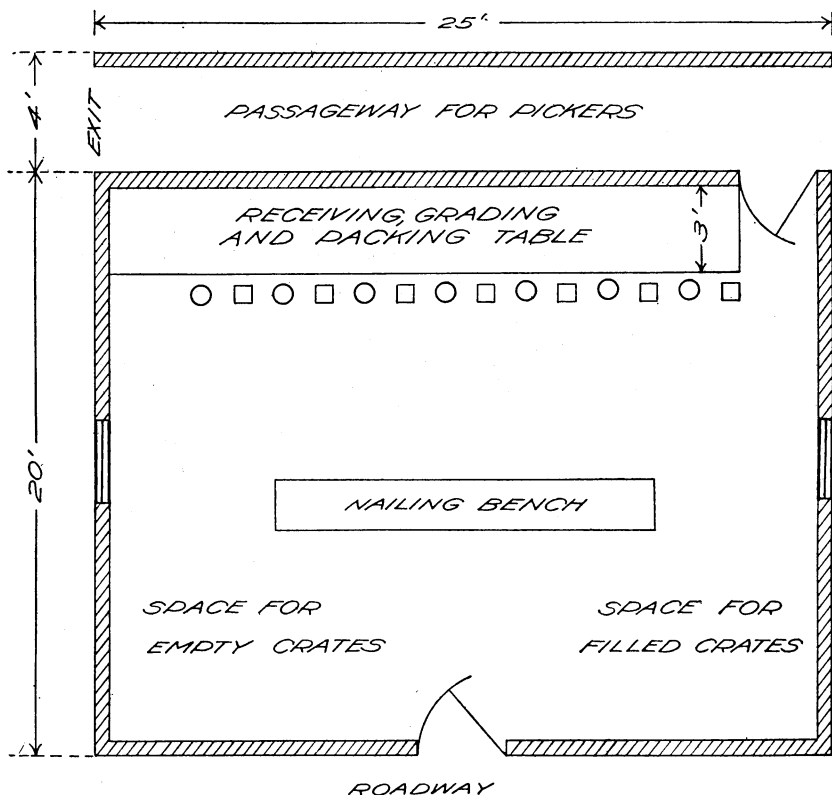


FIGURE 23.—A simple yet satisfactory plan for a strawberry packing shed

bulletin applies. The Klondike is preferred in all districts except those in Florida, parts of North Carolina, and Norfolk, Va. The Missionary is liked best in Florida, where it has almost entirely replaced other sorts. It is also grown extensively in the Wallace and the Norfolk districts but, although very productive, does not ship as well as the Klondike.

In 1930 the Blakemore variety was introduced in the Southeast by the United States Department of Agriculture, to be tested in the

regions where Missionary was raised, except Florida. Compared with the Missionary, it is more vigorous, productive, several days earlier, firmer, and better adapted to preserving. It has succeeded well commercially in the area from southern Georgia to Norfolk, Va., and should be tested throughout the region to which this bulletin applies. Growers, however, should realize that although the Blakemore is more vigorous and drought resistant than other sorts, it may set so many runner plants that only a small crop of fruit may be produced. Therefore such cultural methods as will keep the plants 6 to 8 inches apart in the matted beds should be used.

In the winter of 1931-32 the Southland, a new variety for home use in the South, was introduced by the United States Department of Agriculture. This variety is productive and has very high dessert quality, but it has a tender skin that limits its value as a market sort.

New sorts should be tested carefully before large areas are planted to them. If they are to succeed, they must be able to endure the heat and humidity of the southern summer, and must be somewhat resistant to diseases. The varieties now raised in the Southern region originated in the South, and it is not likely that northern sorts will prove adapted to southern conditions. In testing new sorts, therefore, those originating in the South should be regarded as more likely to prove of value than those originating in the North.

STRAWBERRY DISEASES AND INSECT PESTS

No detailed discussion of strawberry diseases and insect enemies can be given in this bulletin. The grower should familiarize himself, so far as possible, with those that are likely to occur in his locality, and thus be able to recognize and combat them as soon as they are discovered. Information on pests and diseases may be found in many bulletins of the State agricultural experiment stations and State agricultural colleges, and in publications of the United States Department of Agriculture.⁶ Growers should keep in close touch with the experiment stations in their own States and upon discovering unfamiliar insects or diseases should send specimens to the stations or to the Department of Agriculture for examination. Early recognition of an insect or a disease newly discovered in a community may make it possible to apply control measures that will prevent a serious outbreak.

USES OF THE STRAWBERRY

Many million dollars' worth of strawberry products are manufactured each year. Among the more important of these are preserves, jams, essences for flavoring candies, flavoring extracts, sirup for soda fountains, and crushed fruit for flavoring ice cream and sauces. The varieties considered best for preserving are light bright red, acid, with a strong strawberry flavor, and firm fleshed, so they will not break to pieces in cooking. Among the best varieties for such purposes is the Missionary, while the Blakemore was introduced as still better and the best for this purpose that is known.

⁶ U. S. Dept. Agr. Bulletin No. 1458, Strawberry Diseases.

COLD STORAGE

Large quantities of strawberries are packed each year for holding in cold storage. Two methods are in common use.

• FIRST METHOD

When it is desired to preserve the fresh-fruit flavor the following method may be used for packing small quantities of strawberries for use when they are not in season: Select sound, ripe berries; wash, drain, and hull them. Use cans of convenient size, to which a tight cover can be fitted. To each 2 or 3 pounds of fruit use 1 pound of sugar; fill the cans with sugar and berries; put on the tops and cover their edges with the adhesive tape used in sealing packages; put in freezing cold storage and keep frozen until wanted. This product can be used for shortcakes, etc., by restaurants and hotels, for crushed fruit at soda fountains, and by ice-cream manufacturers.

SECOND METHOD¹

The large manufacturers of the crushed fruits and sirups used by the soda-fountain and ice-cream trade prepare their product as it is needed at any time during the year from uncooked berries kept in barrels in cold storage and preserved in the following manner: The berries are hulled and sorted and then washed. Various kinds of washing machines are employed. Usually the machine has a water tank at one end, into which the berries are dumped for a brief soaking to loosen the dirt. From this tank they are removed by an endless belt which carries them under sprays of fresh water. This belt delivers them to inspection belts where the water drains away and the final sorting and grading are done. The berries are then put in barrels, with the desired quantity of sugar. Usually, the proportion is 1 pound of sugar to 3 pounds of fruit. The proper proportions will depend on the variety, the ripeness of the fruit, the moisture conditions, and the way in which the product is to be used. Heavy water-tight barrels holding 450 pounds of the mixture of berries and sugar are used. Before being used they are carefully examined and coated on the inside with paraffin applied, while hot, with a paintbrush. New barrels made of some kinds of wood may need special treatment to prevent the berries from absorbing a woody taste.

After the barrels are prepared the sugar and berries are put in in alternate layers and mixed by machine or by hand. A jolting platform which jars the barrel as it is being filled with berries and sugar has come into common use. As soon as the barrels are headed, they are shipped in a refrigerator car to a cold-storage warehouse, where they are stored for at least a week at 0° F. and then held at about 15°. From 75,000 to 125,000 barrels of strawberries, each holding 50 gallons, are put up in this manner every year.

¹ U. S. Department of Agriculture Technical Bulletin No. 148, The Frozen-Pack Method of Preserving Berries in the Pacific Northwest.